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BACKGROUND OF THE INVENTION

A common situation is that a second optic fiber connector lies on a mother card or mother board that is fixed on a support, while a first connector lies on a daughter card or daughter board that can be slid along the support to a final position at which the first connector has fully mated with the second connector. A latch holds the daughter board in its fully installed position on the support. Because of accumulation of tolerances, the daughter board may continue to move forward after the first and second connectors are fully mated, until the daughter board is latched in place. It would be useful if the system could accommodate a range of fully installed daughter board positions while allowing limited movement of optic fibers of the two connectors towards each other to fully mated optic fiber positions. This should be accomplished in a system wherein a first connector frame is fixed to the daughter board.

SUMMARY OF THE INVENTION

In accordance with one embodiment of the present invention, an optic fiber connection system is provided which includes first and second mateable connectors, wherein the first connector has a body that holds optic fiber terminus assemblies that mate with terminus assemblies of the second connector by moving forwardly towards the second connector, the first connector also including a first frame that surrounds the first body. The first frame can slide forwardly while the first body remains stationary in a fully mated position, to accommodate forward sliding of a daughter board on which the first frame is fixed. Such forward sliding of the first frame is against the bias of a spring force that tends to slide the first frame rearward to an initial position relative to the first body.

In one system, a backup lies close behind the body and a pair of rods extend through bores in the backup and in the first frame, with front ends of the rods lying

at the front of the first frame. Springs in the first frame bores bias the rods forwardly, to thereby bias the backup forwardly against the rear of the first body. As the first connector moves forwardly to mate, the optic fibers become fully mated. At that position, a pair of standoffs of the second connector engage front ends of the rods. Further forward movement of the first frame (and the daughter board on which the first frame is mounted) occurs while the rods, backup and body remain stationary.

The novel features of the invention are set forth with particularity in the appended claims. The invention will be best understood from the following description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded isometric view of a connector system of the present invention, with the first and second connectors not yet mated, and showing the first and second connectors respectively mounted on a daughter board and a mother board.

Fig. 2 is an isometric view of the connector assembly of Fig. 1, with the connectors fully mated.

Fig. 3 is a sectional view of the first connector, taken on line 3-3 of Fig. 1.

Fig. 4 is an exploded isometric view of the first connector of the system of Fig. 1, showing the daughter board, and showing in phantom lines a portion of the support.

Fig. 5 is an exploded isometric view of the second connector of Fig. 1, and the mother board, and showing in phantom lines a portion of the support of Fig. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 illustrates a connector system 10 of the present invention which includes first and second optic fiber connectors 12, 14 that can be mated. The second connector includes a second housing 16 that is fixed to a mother board 20. The mother board has been fixed in place in a support 22. The second connector housing 16 has passages 24 that hold second terminii assemblies 26 with tips 28 where the tips of optical fibers lie. The first connector 12 includes a first housing 18 comprising a first frame 30 that is fixed to a daughter board 32. The first housing also includes a first body 34 with passages 36 that hold first terminus assemblies that mate with the second terminus assemblies 26 of the second connector.

The first body 34 lies within a frame passageway 40 of the first frame 30. The first body 34 is slideable in forward F and rearward R longitudinal M directions within the frame passageway. To connect the first and second connectors, the daughter board 32 is moved forwardly F towards the mother board 20 until the daughter board has been fully installed in the support 22. During such forward movement of the daughter board, the first body 34 with its first terminus assemblies, will move forward far enough that the tips 28 of the second terminii will have entered the first passages 36 of the first body 34 and will have fully mated with the first terminus assemblies. However, the daughter board 32 will continue to move forward a small additional distance until the daughter board has been fully installed on the support and is latched in place. During such additional movement of the daughter board 32, the first frame 30 will continue to move forward with the daughter board, while the first body 34 will not move any further forward.

Fig. 2 shows the first and second connectors 12, 14 in their fully mated positions. The first body 34 will have been stopped while the first frame 30 has slid forward around the first body. A backup 50, which originally abutted a rear end 52 of the first body, will not have moved forward with the first frame 30, so there will be a gap of length A between the backup 50 and first frame 30, representing the over

travel of the daughter board 32 beyond the position wherein the terminus assemblies have become fully mated.

Fig. 3 illustrates the first connector 12, showing one of the first passages 36 and showing a terminus assembly 60 that lies in the passage. The terminus assembly includes a terminus 62 that has a terminus body 64 and a ferrule 66 through which an optic fiber 70 passes, with the tip 72 of the optic fiber lying even with the tip of the ferrule. A terminus spring 74 biases the terminus forwardly to the initial position shown in solid lines in Fig. 3. An optic fiber cable 76 trails from the terminus and passes through a hole in the backup 50. It can be seen that the first connector body 34 has a largely rearwardly facing shoulder 77 that abuts a forwardly-facing surface 80 of the backup 50.

A second terminus assembly at 26 with its tip at 27, enters an alignment sleeve 82 and abuts the tip 72 of the first terminus. The first terminus then moves rearwardly against the force of the terminus spring 74, until the tips of the two mating terminii reach position 72A which is about halfway between forward and rearward ends of the alignment sleeve 82. After such full mating, the first frame 30 continues to move forwardly F a short distance. It can be said that the body 34 and backup 50 move rearwardly R relative to the first frame 30, until the rear end of the body has moved to position 34B and the backup has moved to the position 50B. When the terminii tips 27, 72 have engaged and moved to the tip position 72A, a standoff 130 of the second connector first engages a front surface 90 of a rod 102, as will be described below.

A release or rod device 100 is provided, which includes a rod 102 that extends through bores 104, 106 in the frame 30 and in the backup 50, the rod device also including a clip 110 attached to a rear end of the rod. A body spring 112 lying within the bore 104, has a spring rear end 114 that abuts a frame shoulder, and has a spring front end 120 that abuts an enlarged rod front end 122. The spring urges the rod forwardly F, and its clip 110 has a largely forwardly-facing surface 111 that urges the backup 50 and first connector body 34 forwardly to the

initial position shown in Fig. 3. The second connector has a standoff 130 that abuts the rod front surface 90 when the mating pairs of optical terminii have fully mated, so the tips of the first terminii have been pushed rearward to the positions 72A. The standoffs 130 allow the frame 12 to continue moving forward, while the standoff 130 prevents the rod 102 from moving forward. The rods therefore allow the backups 50 and body 34 to remain stationary in the fully mated positions of the pairs of mated terminii. This keeps the body 34 in the fully mated position while allowing the frame 30 to move forward a small distance until the daughter board on which the frame is fixed, has been fully installed in the support. The rods and backup, plus the standoff, form an extension means for allowing the first frame to slide forward with respect to the first body.

Fig. 1 shows that the first connector 12 has two rods 102, 103 lying at opposite sides of the first connector, and in fact, at diagonally opposite corners of the primarily rectangular first connector frame. Two springs are provided, each surrounding one of the rods, each rod having a clip attached to its rear end. Similarly, the second connector 14 has a pair of standoffs 130, 131 that engage the front ends of both rods when pairs of optical fiber terminii have become fully mated. The abutment of the two rods applies forces symmetrically, and avoids large torque tending to tilt the backup 30 and the body 34. As shown in Fig. 3, the front 134 of the body "floats" in that it can shift slightly (on the order of magnitude of 0.5 degree) perpendicular to the longitudinal directions M to enable the terminii to mate despite slight misalignment. During mating, the rear surface 142 (Fig. 1) of the second connector body preferably does not contact the front surface 140 of the first body.

The second connector has a pair of alignment pins 150, 151 that enter alignment bores 154, 156 in the first frame 30 as the connectors approach each other, to assure moderately accurate alignment of the connectors. Front ends of the first passages 36 are tapered, to further help alignment, with ultimate alignment of a pair of terminii ferrules being accomplished by the alignment sleeve 82 shown

in Fig. 3.

Fig. 4 shows that the daughter board 32 is guided in its forward F movement by a pair of support guides 160, 162. A latch 164 with a moveable part mountable on the support or on the daughter board, latches the daughter board in its fully installed position when it has reached that position. The first frame 30 of the first connector 12 is fixed to the daughter board 32 by a pair of screws (not shown) that extend through holes 170 in the daughter board. Fig. 5 shows the construction of the second connector 14. The housing 16 of the second connector includes a second connector body 172 that is fixed in a second connector frame 174, with the fixing occurring so the second body 172 and frame 174 cannot move relative to one another. A coupling 176 fixes the second frame 174 to the mother board 20.

In the connection system that applicant has designed, each of eight first terminus assemblies had terminus springs 74 (Fig. 3) that were pre-loaded to a force of 0.6 pounds, so that all eight springs applied an initial force of 4.8 pounds. Each of the body springs 112 were pre-loaded to a force of 4 pounds, so the body springs urged the body forwardly with a force of 8 pounds. The 8-pound force urging the body forwardly, easily overcomes the rearward force of about 5 pounds that is applied by the eight second terminus assemblies when they deflect the first terminus assemblies rearwardly to the preferred final positions of the terminii. This avoids a situation in which the first body has been moved rearward under the forces applied to it by the terminus springs during mating.

In the designed system, the final gap A (Fig. 2) was designed to be 30 mils (one mil equals one thousandth inch). Tolerances were allowed which resulted in a gap of between 1 mil and 60 mils. The tolerances that resulted in variation in gap width, included tolerances in the exact position of the daughter board 32 when it was fully latched, in the position of the first frame 30 on the daughter board 32, in the position of the second connector on the mother board, and the position of the mother board 20.

It would be possible to slideably mount the first body in the first frame, without the use of the backup and rods and with the rear face (142) of the second connector housing directly abutting the front face (140) of the first body. During mating, one or more springs then could extend directly between the first body and first frame. However, this could lead to forceful tilting of the first body by the rear face (142) of the second connector and/or by the spring(s). Thus, this alternate is not preferred, although possible.

Thus, the invention provides an optic fiber connection system with first and second connectors that each have passages that hold optic fiber terminus assemblies that can mate when the connectors mate, but which allows a frame of the first connector to move in a forward mating direction further than is required for mating without causing corresponding further forward movement of the first terminus assemblies in the first connector. The first connector includes a first body that is slideable rearwardly with respect to a first connector frame, and a body spring apparatus with two springs that urge the first body forwardly towards an initial position while allowing the first body to slide rearwardly by a limited distance relative to the first frame. An extension means that couples the body springs to the body, can include a pair of rods that are biased forwardly by a pair of body springs, with rear ends of the rods having clips or other parts that limit rearward movement of a backup. The backup abuts the rear of the body to prevents its rearward movement relative to the frame unless the rods are deflected rearwardly.

The novel features of the invention are set forth with particularity in the appended claims. The invention will be best understood from the following description when read in conjunction with the accompanying drawings.